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ScienceDirect

Procedia - Social and Behavioral Sciences 174 (2015) 759 – 767

Procedia
Social and Behavioral Sciences

INTE 2014

E-learning system in blended learning environment to enhance cognitive skills for learners in higher education

Jintavee Khlaisang[a]* and Maneerat Likhitdamrongkiat[b]

[a] Associate Professor, Department of Educational Technology and Communications, Chulalongkorn University, Bangkok, 10330, Thailand (jintavee.m@chula.ac.th)
[b] Lecturer, Department of Multimedia Technology, Faculty of Engineering and Architecture, Rajamangala University of Technology Isan, Nakhon Ratchasima 30000, Thailand (m2nual@gmail.com)

Abstract

This research aims to develop the e-Learning system in Blended Learning Environment (BLE) to enhance cognitive skills for higher education learners. The system was developed based on the survey of 400 higher education instructors. Then, it was tested by 120 students in three major disciplines established by OHEC Thailand. Data analysis indicated that there was statistical difference between pre and post test scores at .05 level of significant. Then, the system was approved by the experts. Accordingly, the results showed that the system should consist of four core elements along with 14 sub elements as detailed in the article.

Peer-review under responsibility of the Sakarya University

Keywords: E-Learning System; Blended Learning; Environment; Cognitive Skills; Higher Education

1. Introduction

According to the National Education Act B.E. 2542 (1999) introducing education reform that focused on student-based learning, along with the use of technology to support suitable learning process to students, the Office of Higher Education set out Thailand Qualifications Framework for Higher Education. The Framework defined three qualifications for higher education emphasizing to support students to have knowledge and specialize in their discipline, create and apply knowledge to develop themselves, and work to develop country for global

* Corresponding author. Tel.: +662-218-2644 ; fax: +662-218-2644
E-mail address: jintavee.m@chula.ac.th

Peer-review under responsibility of the Sakarya University
doi:10.1016/j.sbspro.2015.01.612

competitiveness. The qualifications were also relevant to the standards in creating and developing knowledge-based society. Therefore, higher educational institutes have to change teaching methods to respond to the above mentioned qualifications (Ministry of Education Gazette: Qualifications Framework for Higher Education, 2009; Royal Gazette: Qualifications Framework for Higher Education, 2009; Office of Higher Education Notice: Implementation on Qualifications Framework for Higher Education, 2009). The Qualifications Framework for Higher Education focused on enhancing cognitive skills of learners. According to the Framework on cognitive skills emphasizing on the academic disciplines (Bureau of Higher Education Standards and Evaluation, 2004), cognitive skills for learners in Health Sciences included problem solving, systematic thinking, analytical thinking, and scientific process. Cognitive skills for learners in Science and Technology included problem solving, analytical thinking, creative thinking, and critical thinking. Cognitive skills for learners in Humanities and Social Sciences include problem solving, analytical thinking, creative thinking, and applicative thinking (Bureau of Higher Education Standards and Evaluation, 2009).

According to the National Education Act B.E. 2542 (1999), section 9 and the Qualifications Framework for Higher Education on enhancing cognitive skills, blended e-Learning is learning which combines the benefit of classroom and online learning in content delivery, activities, and measurement and evaluation. Blended e-Learning has become widespread in higher education because of its flexibility for instructors to integrate educational technology in teaching. Also, instructors can offer more effective teaching by implementing student-centered method. Students can access and study contents anywhere and anytime. They can participate and exchange ideas in classroom and learning social media. Therefore, instructors can improve learner's cognitive skills and necessary learning attitudes in the classroom period. There are six important elements for the designing of this teaching method: courseware, learning management system, communication, evaluation, instructor's role, learner's role, supporter's role, and pedagogy. The ratio of the teaching method is online teaching at 30-79% and classroom teaching 21-70% (Khlaisang, 2012; Khlaisang, 2010; Bonk & Graham, 2006; Waterhouse, 2005; Wilson &Smilanich, 2005; Sloan Consortium Foundation, 2005).

From the above issues, the author concluded that higher education students were an important target group that should be developed cognitive skills to respond to education reform on self-paced learning and lifelong learning that emphasized on preparing learners for technology and the Qualifications Framework for Higher Education on cognitive skills development. Knowledge gained from this research will contribute to the advancement of academic discipline on technology and communication studies by developing e-Learning system to enhance the cognitive skills of higher education learners. The research will be used as an example for the integration of education technology and education science because there has not been any e-Learning system to enhance cognitive skills for higher education yet. Therefore, it is needed to develop e-Learning system to enhance cognitive skills for higher education which will be applied in higher education.

2. Objectives

This paper is a report on the findings of a study conducted on e-Learning system in Blended Learning Environment (BLE) to enhance cognitive skills for learners in higher education. This project is a sub project research under the research on "E-Learning System to Enhance Cognitive Skills for Learners in Higher Education" which consists of two sub projects:1) "E-Learning System to Enhance Cognitive Skills in Virtual Learning Environment for Learners in Higher Education" which present a learning design for the future classroom, and 2)"E-Learning System to Enhance Cognitive Skills in Blended Learning Environment for Learners in Higher Education" which present a learning design for the present classroom. Accordingly, the objectives of this research were: (1) to study input and process of e-Learning system in BLE to enhance cognitive skills for learners in higher education, (2) to develop e-Learning system in BLE to enhance cognitive skills for learners in higher education, (3) to study the result e-Learning system in BLE to enhance cognitive skills for learners in higher education, and (4) to present e-Learning system in BLE to enhance cognitive skills for learners in higher education.

3. Research Question & Hypothesis

The research question is what and how are the input, process, output, and feedback of e-Learning system in BLE to enhance cognitive skills for learners in higher education. The hypothesis is there will be statistical difference between pre and post test scores at .05 level of significant.

4. Research Method & Results

This paper is a report on the findings of a study conducted on e-Learning system in BLE to enhance cognitive skills for learners in higher education. The methodology of this study was R&D research. The instruments in this

research consisted of: (1) the learning activities' plans, (2) the cognitive skills test, and (3) the learners' observation record form. The methodology was conducted in accordance with the objectives as detailed in the followings.

Phase 1: To examine input and process of e-Learning system in BLE to enhance cognitive skills for learners in higher education

Research phase 1 was conducted to examine instructors' opinion on e-Learning system in BLE as detailed in the followings.

Research Method

1. Study, analyze, and synthesis concepts, theories, and researches on (1) e-Learning system in BLE to use as basic information to identify input, process, output, and feedback of blended e-Learning system to enhance cognitive skills for learners, and (2) pedagogy on e-Learning in BLE to enhance cognitive skills to use as basic information to create a beta blended e-Learning system to enhance cognitive skills for learners and to identify a concept in enhancing cognitive skills of learners.

2. Study opinions of 400 higher education instructors out of 153,499 instructors under the Office of Higher Education Commission (Bureau of General Administration, Office of Higher Education Commission, 2010). The formula of Taro Yamane to calculate the sample size (n) with an acceptable random sampling error is ± 5% (Yamane, 1973) was used to study the input which is the process of teaching and learning using e-Learning system to enhance cognitive skills for learners in higher education. The result was integrated with information from step 1 develop the beta system.

Research instruments

The researcher used a questionnaire to study the input which was the process of e-Learning system in BLE to enhance cognitive skills for learners in higher education. The questionnaire was used as an instrument to collect data from the sample group. The details included (1) General information of instructors, (2) Elements and process of e-Learning, (3) Pedagogy, including teaching principles, teaching methods, and teaching process that affected cognitive skills of three disciplines, (4) Skills in information and communication technology and experiences in using e-Learning to enhance cognitive skills of higher education learners in lines with the needs and current context, and (5) Information about the institute to study the readiness in supporting e-Learning to enhance cognitive skills for learners.

Research results

The result of research phase 1 that studied the input which was the process element of e-Learning system in BLE to enhance cognitive skills for learners in higher education. Data analysis was divided into 2 parts.

1. Analysis of the priorities of cognitive skills in three disciplines from the experts, it was found that (1) Health Sciences, the first 3 skills were systematic thinking, analytical thinking, and application, (2) Science and Technology, the first 3 skills were scientific process, systematic thinking, analytical thinking, and (3) Humanities and Social Science, the first 3 skills were creative thinking, analytical thinking, systematic thinking. This result will be used for further analysis in this research.

2. The result of the study of opinions from 400 instructors to study the current situation and the readiness of instructors for e-Learning system in BLE.

Part 1 General information of higher education instructors

The survey about general information of instructors in higher education found that gender: most respondents were female, accounted for 56.3 percent, age: most respondents were aged between 31-40 years, accounted for 34.0 percent, educational level: most respondents had Master's degree, accounted for 44.8 percent, and teaching disciplines: most respondents taught in Humanities and Social Science at 39.3 percent, Health Sciences at 34.0 percent, and Science and Technology at 26.8 percent, respectively. Details are shown in Table 1.

Table 1: General information of the respondents

General information	Persons	Percent
1.Gender		
Male	175	43.8
Female	255	56.3
Total	400	100
2.Age		
Between 20-30 years old	88	22.0
Between 31-40 years old	136	34.0
Between 41-50 years old	110	27.5
Above 51 years old	66	16.5
Total	400	100
3.Highest educational level		
Bachelor's Degree	77	19.3
Master's Degree	179	44.8
Doctoral Degree	79	19.8
Others	65	16.3
Total	400	100
4.Teaching disciplines		
Health Sciences	136	34.0
Science and Technology	107	26.8
Humanities and Social Science	157	39.3
Total	400	100

Part 2 aims to study the use of computers to check the readiness of the instructors for e-Learning system in BLE. It was found that the respondents used computer for working 100 percent. For the frequency of using computers per week, it was found that most respondents used computers to work every day, accounted for 92.0 percent, followed by 3-4 days per week at 4.0 percent. For the question of owning the computer, it was found that most respondents had their own computer at 96.2 percent and most did not share it with colleagues at 77.8 percent. For the question of the use of computers, most respondents used computers for information searching at 20.8 percent, followed by preparing teaching materials at 17.1 percent.

The question about the use of smart phones by the students found that most students used smart phones, accounted for 72.7 percent. As for tablets, most respondents did not use tablets, accounted for 75.8 percent, followed by using tablets at 24.2 percent. Most respondents who used tablets used Samsung (GalaxyTab) at 50.5 percent. For the question of using tablets in teaching, it was found that most respondents did not use tablets in teaching at 59.7 percent. Most students in the respondents' class did not use tablet at 58.3 percent. As for e-Learning question, most respondents have offered blended/hybrid learning at 48.3 percent, followed by web-facilities learning at 44.1 percent.

Table 2 Information of respondents on the use of computers

Information on the use of a computer	Persons	Percent
1. Do you use a computer at the workplace?		
Yes	400	100
No	0	0.0
2. The frequency of using a computer per week.		
Everyday	366	92.0
4-3times a week	16	4.0
1-2times a week	13	3.3
Others	3	0.8
3. Do you have your own a computer for work?		
Yes	379	96.2
No	15	3.8
4. Do you share the computer at your workplace with colleagues?		
No	309	77.8
Yes, with 1-2 colleague (s)	35	8.8
Yes, with 5-3colleagues	35	8.8
Yes, with 10-6colleagues	18	4.5
5. What do you use a computer for? (Multi answers are acceptable.)		
Analyzing students' learning results	241	13.8
Preparing teaching materials	298	17.1
Searching information	364	20.8
Teaching and making lessons	257	14.7

Information on the use of a computer	Persons	Percent
Presenting	275	15.7
Analyzing data	239	13.7
Others	73	4.2
6. Do the students in your class use a smart phone?		
Yes	282	72.7
No	106	27.3
7. Do you use a table such as iPad, Samsung Galaxy Tab		
Yes	96	24.2
No	301	75.8
8. Which tablet do you use?		
Apple (iPad)	44	47.3
Samsung (Galaxy Tab)	47	50.5
Others	2	2.2
9. Do you use a tablet in teaching?		
Yes	58	40.3
No	86	59.7
10. Do the students in your class use a tablet?		
Yes	148	41.7
No	207	58.3
11. Which type of e-Learning have you used?		
Web-Facilitated	199	44.1
Blended/ Hybrid	218	48.3
Virtual Learning Environment	34	7.5

Part 3 shows the data of the respondents on the use information technology in teaching to design e-Learning system in BLE to enhance the cognitive skills of higher education learners. It was found that most respondents have used Learning Management System (LMS) at 71.6 percent. Most have used the electronic book (E-Book), accounted for 73.4 percent, file sharing tools, at 78.6 percent, web application tools at 72.5 percent, communication tools at 88.4 percent, community tools at 88.9 percent, and streaming video at 89.2 percent. Details are shown in Table 3.

Table 3: Experiences in using technology in teaching

Information on the use of technologies in teaching	Persons	Percent
1. Have you ever used LMS: Learning Management System?		
Yes	285	71.6
No	113	28.4
.2Have you ever used E-Book?		
Yes	292	73.4
No	106	26.6
3. Have you ever used file sharing tools?		
Yes	313	78.6
No	85	21.4
4. Have you ever used web application tools?		
Yes	287	72.5
No	109	27.5
5. Have you ever used communication tools?		
Yes	352	88.4
No	46	11.6
6. Have you ever used community tools?		
Yes	354	88.9
No	44	11.1
7. Have you ever used streaming Video?		
Yes	355	89.2
No	43	10.8

Phase 2: To develop e-Learning system in BLE to enhance cognitive skills for learners in higher education

Research Method

1. Study opinions of the experts about the results from phase 1 to develop a prototype of e-Learning system in BLE to enhance cognitive skills for learners. Issues in consideration included input, process, output, and feedback. Also, the experts considered about the transfer of meaning, the covering of contents, and the appropriateness of

using the system. Suggestions from the experts from the interview about e-Learning to enhance the cognitive skills of higher education learners were used to improve the prototype.

2. The experts evaluated the prototype of e-Learning system in BLE on the input, process, output, and feedback. The experts included professionals on the developing of e-Learning system in BLE to enhance the cognitive skills of higher education learners and on higher educational framework.

3. Design and develop e-Learning system in BLE from the prototype suggested and approved by the experts in phase 1 and 2. The steps included (1) designing e-Learning system in BLE which featured web applications and traditional classroom by creating site structure and storyboard; (2) developing learning activities' plans of e-Learning system in BLE based on information from studying, analyzing, and synthesizing of concepts, theories, and researches on blended e-Learning and cognitive skills; (3) developing the cognitive skills test of learners. Products from above 3 steps were evaluated by the experts in each field and tested with the sample group.

4. Develop e-Learning system in BLE with LMS that had plugin which was open source software with PHP language and MySQL Server .The system included e-Learning courseware, communication tools, and assessment and evaluation tools. The system was tested and tried out with the sample group. Then an instruction manual of e-Learning system in BLE would be developed in the next phase.

5. Organize the focus group of 15 experts, presenting the developed research instruments. The experts reviewed, brainstormed, and commented.

Research instruments

Research phase 2 had 3 forms for collecting data. They were interview forms for the experts, including a structured interview form, an approval evaluation form for e-Learning in BLE to enhance the cognitive skills of higher education learners, and a focus group record form.

Research results

The focus group was organized to review the prototype of e-Learning system in BLE to enhance the cognitive skills of higher education learners. There were 4 components of the system that were reviewed: (1) the model of e-Learning system in BLE to enhance the cognitive skills of higher education learners; (2) input: elements of teaching and the appropriateness of tools and technology to enhance the cognitive skills of learners; (3) process: the appropriateness of 5 cognitive skills, including creative thinking, analytical thinking, systematic thinking, applicative thinking, and scientific thinking; (4) output that was relevant to 5 cognitive skills. The experts reviewed the issues including the transfer of meaning, the covering of contents, and the appropriateness of using the system. Also, suggestions have been made about e-Learning to enhance the cognitive skills of learners. Overall, the average scores of the opinions were at the highest level. There were suggestions on improving the system. E-Learning system in BLE to enhance cognitive skills for learners in higher education will be presented in research phase 4.

Phase 3: To study the result e-learning system in BLE to enhance cognitive skills for learners in higher education Research phase 3 aims to study the result of the test of e-Learning system in BLE to enhance cognitive skills for learners in higher education. The sample group in the research was selected by purposive sampling method. The group included volunteer undergraduate students in the institutes under OHEC which had readiness in ICT. The sample group consisted of 120 students, including 40 students in Health Sciences discipline, 40students in Science and Technology discipline, and 40students in Social Sciences and Humanities discipline.

Research method

Research method were: (1) the sample group of students studied in the developed e-Learning system in BLE for one semester, then the researcher followed the process by defining input, process, output, and feedback as the experts suggested in phase 2; (2) the students took pre-test and post-test of cognitive skills. The results were analyzed in the next step; (3) during the research, the observation was made in teaching process, group learning, and behaviors showing the development of cognitive skills; and (4) the students did an opinion survey on e-Learning in BLE in the last part of the research.

Data Analysis

In this research, data was collected from the results of the assessment of cognitive skills of the sample group, the scores of learning behavior assessment that presented the development of cognitive skills by self- assessment and assessment from classmates, instructors, or observers, and opinions on the e-Learning system in BLE of the sample group. However, this paper will present only the results of the analysis of frequency and percentage of the sample group and the results of data analysis of cognitive skill assessment, using the t-test statistics.

Research instruments

Research instruments included e-Learning system in BLE, system developing and instruction manual, and cognitive skills test.

Research results

Data analysis of cognitive skills test of the sample group used the statistical t-test including the mean ($\overline{X}$), standard deviation (SD) and the compared average scores of the cognitive skill pre-test and post-test of students from all three disciplines. It was found that there was statistical difference between pre-test and post-test scores at .05 level of significant. **Students in Health Sciences discipline** have an average score of cognitive skills pre-test at 36.45 with standard deviation at 10.563 and average score of post-test at 64.90 with standard deviation at 15.772. **Students in Science and Technology discipline** have an average score of cognitive skills pre-test at 40.91 with standard deviation at 20.488 and average score of post-test at 83.58 with standard deviation at 11.154. **Students in Social Sciences and Humanities discipline** have an average score of cognitive skills pre-test at 34.65 with standard deviation at 8.793 and average score of post-test at 67.09 with standard deviation at 18.039.

Table 4: Data analysis of mean ($\overline{X}$), Standard Deviation (SD), and the results comparing the average scores of cognitive skills of pre-test and post-test of the students in three disciplines.

Discipline	Test	n	$\bar{x}$	S.D.	t	Sig.
Health Sciences	Pre-test	40	36.45	10.563	-10.861	000.*
	Post-test	40	64.90	15.772		
Science and Technology	Pre-test	40	40.91	20.488	-12.912	000.*
	Post-test	40	83.58	11.154		
Social Sciences and Humanities	Pre-test	40	34.65	8.793	-10.479	00.0*
	Post-test	40	67.09	18.039		

*P <.05

Phase 4: To present e-Learning system in BLE to enhance cognitive skills for learners in higher education

Phase 4 is to present e-Learning system in BLE to enhance cognitive skills for learners in higher education. The results from the study of the use of blended e-Learning were used to improve the system. The system was presented to the focus group to be approved.

Research method

Research method included: (1) research results from phase 3 were used to improve the system. The system was presented in diagram and essay; (2) present the system to the focus group, including instructors, institute administrators, and experts in e-Learning in BLE, cognitive skills, quality framework of higher education, and educational innovation. The focus group commented and approved e-Learning system in BLE; (3) analyze data of the e-Learning in BLE approval form using the mean and standard deviation. Then the results and comments from the experts were used to improve the system; and (4) improve the system and present it in diagram and essay.

Research instruments

Research instrument used in this phase was the approval form of e-Learning in BLE. The approval form was developed by using the result from phase 3: (1) input, (2) process, (3) output, and (4) feedback. The form used Likert Scale of 5 level and open-ended questions.

Research results

From the research phase 4, the e-Learning system in BLE to enhance cognitive skills for learners in higher education was presented. It contained four core elements along with 14 sub elements, including (1) Input which is elements such as learner's role, instructor's role, learning environment, learning resources, and motivation, (2) Process which is the process of teaching management including analytical thinking process, creative thinking process, scientific thinking process, systematic thinking process, and applicative thinking (this process will take the result of e-Learning system in blended learning environment and e-Learning in virtual environment of sub projects to analyze and develop perfect e-Learning system), (3) Output which is cognitive skills, and (4) Feedback which is the system assessment as shown in Figure 1.

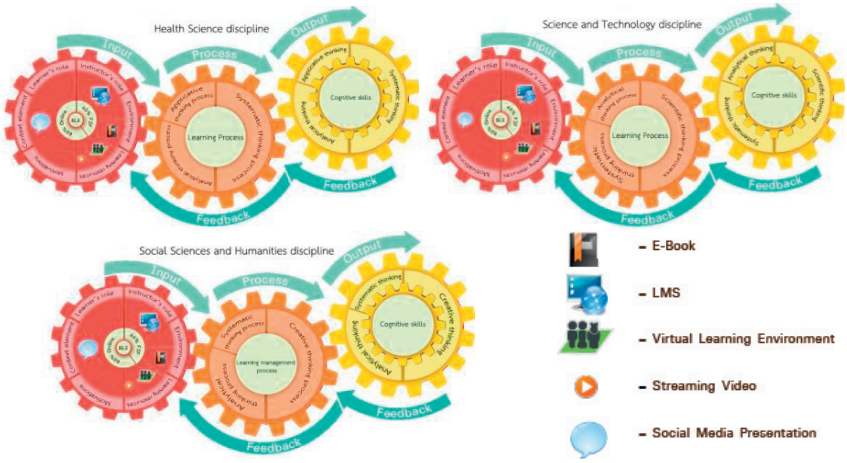

Figure 1: E-Learning System in Blended Learning Environment

5. Conclusion

This paper is a report on the findings of a study conducted on e-Learning system in Blended Learning Environment (BLE) to enhance cognitive skills for learners in higher education. This project is a sub project research under the research on "E-Learning System to Enhance Cognitive Skills for Learners in Higher Education" which consists of two sub projects:1) "E-Learning System to Enhance Cognitive Skills in Virtual Learning Environment for Learners in Higher Education" which present a learning design for the future classroom, and 2)"E-Learning System to Enhance Cognitive Skills in Blended Learning Environment for Learners in Higher Education" which present a learning design for the present classroom. The methodology of this study was R&D research with the objective to develop blended e-Learning system to enhance cognitive skills for learners in higher education. The research methods included Phase 1: to examine input and process of e-learning system in BLE to enhance cognitive skills for learners in higher education; Phase 2: to develop e-learning system in BLE to enhance cognitive skills for learners in higher education; Phase 3: to study the result e-learning system in BLE to enhance cognitive skills for learners in higher education; and Phase 4; to present e-learning system in BLE to enhance cognitive skills for learners in higher education. The research results answered the question of the basis and importance of the use of educational technology by developing e-Learning system in BLE to enhance cognitive skills for learners in higher education. Also, it was a model of integrating educational technology and pedagogy to enhance cognitive skills for learners in higher education which will lead to the application in higher education.

Acknowledgment

This paper was a part of the project funded by the National Research Council of Thailand (NRCT) in 2012. The author would like to express our sincere appreciation to NRCT for the support. Sincerely thank must also go to Chulalongkorn University and Thailand Cyber University Project who are the supported institutes. Special thanks also go to all advisors, scholars, and experts for their help and support in creating new knowledge via this paper to strengthen the educational technology and communications field.

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